**ATTACHMENT 27**

**DAAE07-01-R-S001**

**06 Oct 00**

## HFE/MANPRINT ANALYSIS AND ASSOCIATED DESIGN CHANGES

U.S. Army Research Laboratory prepared a Human Engineering Assessment (HEA) for the Family of Medium Tactical Vehicles on 15 June 1995. None was prepared for the FMTVA1 program.

The HEA focused on (1) personnel heat stress; (2) Manpower Personnel, and Training (MPT) resources; (3) ingress and egress to the vehicle; (4) lack of communication between troop seat occupants and driver; and (5 inadequate access to the vehicle battery.

No critical problems or concerns were identified.

The only major concern expressed was the concern that the vehicle occupants may be at risk when operating at temperatures near the required 120 degrees F in which the vehicle is required to perform. **The Health Hazard Assessment Report concluded FMTV ventilation system meets the hot climate ventilation requirements while the vehicle is moving with windows opened. The Technical Manuals include the recommended administrative controls for stationery operations or situations that precluded opening the windows.**

Four minor concerns were identified:

1. Lowest step used for entering FMTV cab is too high at 26 inches above the ground. **It was determined that having the lowest step at 26 inches above the ground were operational acceptable. There are grab handles for personnel to hold while entering/exiting the cab.**

2. The soldier-machine interface for the LMTV van's ladder is degraded due to its steep angle, narrow step width, and lack of an appropriate handrail. **The rear entrance ladder was redesigned and tested during the Follow-On Production Test. No problems found with the redesigned ladder.**

3. The lack of the ability of the troops in the dump truck cargo area to communicate with the driver in an emergency when the vehicle is moving was a concern. **A troop transport alarm was added to the dump truck troop seat kit. Passengers in the cargo area use it to warn the driver of an emergency.**

4. Shortcomings were reported concerning the inspection, maintenance, and replacement of the vehicle batteries. **A battery electrolyte tester was made available. It enables the operator to easily check the rear batteries electrolyte levels with an attached go/no-go light.**

# HUMAN ENGINEERING ASSESSMENT
# FOR THE
# FAMILY OF MEDIUM TACTICAL VEHICLES
# MILESTONE ASARC IIIB FULL RATE PRODUCTION DECISION REVIEW

15 JUNE 1995

PREPARED FOR
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HUMAN ENGINEERING ASSESSMENT
FOR THE
FAMILY OF MEDIUM TACTICAL VEHICLES

## 1. Summary

A. Requesting Activity. This Human Engineering Assessment (HEA) for the Family of Medium Tactical Vehicles (FMTV) was prepared at the request of the Department of the Army, Office of the Deputy Chief of Staff for Personnel.

B. System Description. The FMTV includes both 2 1/2-ton Light Medium Tactical Vehicles and 5-ton Medium Tactical Vehicles. Maximum practical commonality and several mission oriented body configurations and kit applications are employed to satisfy the Army's ground transportation requirements within the specified payloads.

C. Conclusions. The overall soldier-machine interface for the FMTV is superior to that of the predecessor vehicles. The FMTV has a much lower maintenance ratio than its predecessors and will be approximately four times more reliable than the vehicles it replaces. However, the specific issues identified in this report have the potential to negatively affect crew performance if not corrected.

D. Recommendation. From a Human Engineering standpoint and based on the data available, it is recommended that the Family of Medium Tactical Vehicles' program transition to the Full Rate Production Phase of the Materiel Acquisition Life Cycle with priority attention directed to the specific issues identified in section III.

## II. Introduction

A. Human Engineering Assessment. An HEA is a review of the status of the human engineering concerns for a system as it approaches the end of a developmental phase of the Materiel Acquisition Life Cycle. Its purpose is to influence and support the Milestone Decision Review Process that determines if the system is ready to transition to the next scheduled phase. Broad areas addressed by the HEA are human engineering detail design and soldier performance considerations as they relate to the operation, maintenance, and support of the system being evaluated and how these factors might impact the system's pre-established Manpower, Personnel, and Training (MPT) goals and constraints. A major thrust of the HEA is to identify any design flaws, which when taken singularly or collectively, may be so objectionable, that if not remedied, would warrant a decision not to transition to the next phase. This HEA will also identify problems or concerns which are not serious enough to preclude transitioning but should be resolved to enhance total system operational effectiveness.

B. Data Sources and Data Voids.

### 1. Data Sources

a. Human Factors Engineering Assessment for the Family of Medium Tactical Vehicles (FMTV), Milestone I and II ASARC, Jun 86, prepared by Human Engineering Laboratory, TACOM Detachment, ATTN: SLCHE-TA, Warren, Michigan 48397-5000.

b. Human Factors Engineering Assessment for the Family of Medium Tactical Vehicles (FMTV), Milestone IIIA ASARC, Jan 91, prepared by Human Engineering Laboratory, TACOM Detachment, ATTN: SLCHE-TA, Warren, Michigan 48397-5000.

c. Military Standard 1472D, entitled Human Engineering Design Criteria for Military Systems, Equipment, and Facilities, dated Mar 89.

d. Army Regulation 611-201, entitled Enlisted Career Management Fields and Military Occupational Specialties, dated Oct 86.

e. System Safety Program Progress Report for the FMTV, prepared by Stewart and Stevenson, CDRL item A03J for TACOM, dated Jan 95.

f. Military Standard 1180, entitled Safety Standards for Military Ground Vehicles, dated Sep 86.

g. Draft human engineering section of test report for FMTV performed at USA Yuma Proving Ground, dated 12 Apr 95.

h. Draft human engineering section of test report for FMTV performed at USATECOM, CSTA, dated Oct 94.

i. Integrated Logistics Support Plan (ILSP) which includes LMTV test data, M35A2 man-hours from QQPRI, miles per year requirement; published by TACOM, PEO, Tactical Management Branch, dated May 94.

j. Comparison of LMTV and M35A2 Maintenance Man-hour Requirements, memo from TACOM Fleet Planning Office (AMSTA-TR-L), dated Apr 95.

k. Light Medium Tactical Vehicles Test, an internal TACOM report from Quality Direct Support Team (AMSTA-TR-QS), dated Apr 95.

l. Logistic Management Analysis Summary for M35A2, which includes SDC maintenance ratio based on 64,746 peacetime usage miles, dated Feb 93.

m. Environmental Medicine Support for Desert Operations, published by the U.S. Army Research Institute of Environmental Medicine, 1978.

n. Isodecrement Curves for Task Performance in Hot Environments reported in Applied Ergonomics, Vol 9, pages 66-72, 1978.

2. **Data Voids**

There are no known data voids.

C. Requesting Agency, Milestone, and Type of Review. This Human Engineering Assessment (HEA) for the Family of Medium Tactical Vehicles (FMTV) was prepared at the request of the Department of the Army, Office of the Deputy Chief of Staff for Personnel, in support of the Milestone Decision Review IIIB Army Systems Acquisition Review Council (ASARC) for Full Rate Production.

D. System Description and Background.

1. System Description

a. Predecessor Vehicles:

(1) The predecessor vehicles for the FMTV, Light Medium Tactical Vehicles (LMTV) consist of the M35 and M44 series 2 1/2-ton trucks.

(2) The predecessor vehicles for the FMTV Medium Tactical Vehicles (MTV) consist of the M809 and M939 series of 5-ton trucks.

b. The FMTV is comprised of the following wheeled variants, which are based on a common cab and chassis:

(1) Light Medium Tactical Vehicles (2 1/2-ton LMTV) including LMTV base chassis, LMTV cargo truck (Figure 1), and LMTV van.

(2) Medium Tactical Vehicles (5-ton MTV) including MTV base chassis (which includes long wheel bases), MTV cargo truck (which includes long wheel bases and materiel handling cranes), MTV dump truck, MTV wrecker, and MTV tractor.

c. The FMTV's primary mission within the designated theater of operations is unit mobility, unit resupply, and transportation of equipment and supplies within the specified range of payloads.

d. The FMTV (LMTV and MTV) will be utilized by the designated target audience (which includes both male and female soldiers) in combat support and combat services support units. The size of the vehicle crew varies, depending on the different mission oriented, vehicle-body configurations and kit applications, but will always include a driver.

e. The Human Engineering description of the FMTV includes the following major soldier-machine interfaces:

(1) Vehicle cab - The variants of the LMTV and MTV share a cab design that is essentially common but may differ in some aspects, such as secondary controls and displays, due to dissimilar missions. This common cab represents the first major soldier-machine interface for the FMTV. The driver and two secondary passengers or two secondary equipment operators may occupy this three-person cab when performing some mission functions. Secondary equipment operators may occupy other specified areas of the vehicle, such as the van in some vehicle configurations.

(2) Vehicle maintenance - Access to and workspace within the engine compartment of the FMTV tractor will be common. Operator-performed Preventive Maintenance Checks and Services (PMCS) and other designated maintenance functions, which include spare tire removal and replacement and other labor intensive tasks, represent the second major soldier-machine interface for the FMTV.

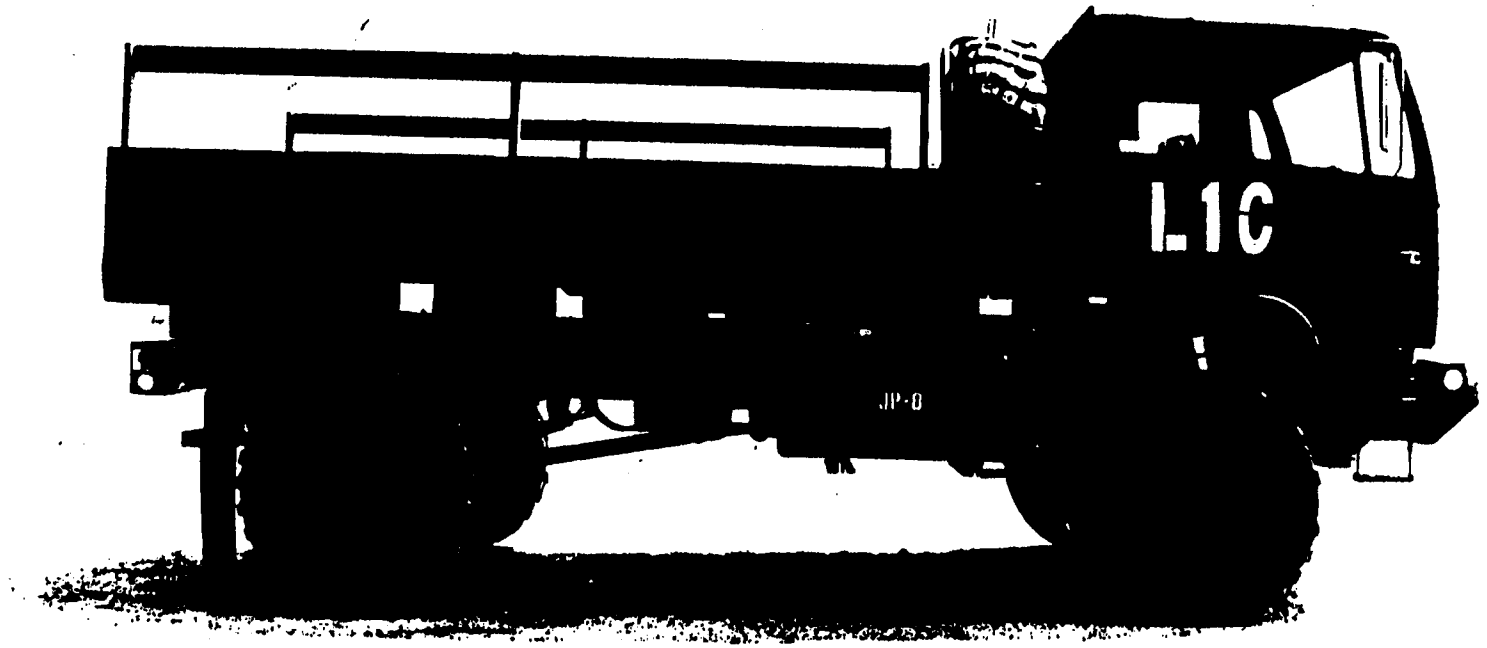


Figure 1. LIGHT MEDIUM TACTICAL VEHICLE (2½-TON LMTV) CARGO TRUCK

(3) The LMTV van - The vans will be utilized to house various communications equipment or assorted maintenance equipment and supplies on some mission-oriented configurations. The consoles associated with communications equipment and the precision workspaces required for maintenance tasks represent major soldier-machine interfaces in some fielded vans.

(4) LMTV and MTV cargo body and troop area - Cargo body seating, which must accommodate the full range of user personnel, will utilize a standard troop seat kit and is considered to be a significant soldier-machine interface area. Other significant soldier-machine interface aspects of the cargo body include ingress and egress, access and manipulation of the tailgate and or side panels, tie-down configurations, and cargo body cover installation.

(5) Variant specific soldier-machine interfaces - Access and manipulation of specific controls and components, which are unique to specific LMTV or MTV variants and represent mission-oriented kit functions, provide minimal commonality due to basic differences in variant designs. Such areas as dump trucks, wreckers, and materiel-handling cranes may represent significant soldier-machine interfaces.

2. Acquisition Strategy

The FMTV program utilizes a non-developmental item (NDI Level 3), accelerated hands-off acquisition strategy, with competitive prototype testing. Fixed price prototype contracts were awarded to three contractors, each of which produced 15 test vehicles. After completion of the prototype phase (Milestone IIIA, Oct 91), a Low Rate Initial Production (LRIP) was awarded to Stewart and Stevenson, who produced 1200 vehicles. Full production (Milestone IIIB, Aug 95) is scheduled to produce 10,834 vehicles.

3. Previous Human Engineering Assessments

Human Engineering Assessments (i.e., Human Factors Engineering Assessments or HFEAS) for the FMTV are as follows:

a. An HFEA was conducted for Milestone Decision Review I and II, Army Systems Acquisition Review Council(ASARC), on 30 Jun 86. It recommended that the FMTV transition to the full scale development phase with priority attention directed to the following areas of potential concern on the generic candidate vehicles and their variants:

(1) Adequacy of the soldier-machine interface including anthropometric size, human strength, and protective garment limitations.

(2) Commonality and standardization of components, such as the instrument panels between vehicle variants.

(3) Dedicated personal stowage provisions within the vehicle cab.

Each of the above three areas of concern was considered by the three potential contractors for the FMTV program and was reflected to varying degrees in the prototype vehicles submitted for Government testing.

b. A second HFEA was conducted for Milestone Decision Review IIIA ASARC on 10 Jan 91. It recommended that the FMTV transition to the Low Rate Initial Production Phase with priority attention directed to the following areas on the candidate vehicle and its variants:

(1) Human strength capabilities relative to performing the tasks associated with replacing a flat tire. This includes concerns such as loosening lug nuts which have been tightened with impact wrenches at a depot or other facility, and the weight of the tire assembly (190 pounds) which exceeds individual human lift capability. It was recommended that procedures be developed and published to facilitate tire changing by one soldier in the field. These procedures are to be incorporated into the vehicle operator's manual.

(2) The Materiel Handling Crane (MHC) for the light cargo trucks was reported to be difficult to operate and inadequate for the tasks required of it by the testing agency. It was recommended that studies be performed to determine the adequacy of the MHC and that appropriate modification, redesign or replacement be implemented to resolve the problems identified. This recommendation was incorporated and a new crane was installed. This MHC is scheduled to be evaluated in Jun 95.

(3) Noxious fumes were reported during early testing by personnel who were operating the crane when the vehicle engine was running. The new crane has a remote control on a 50-foot umbilical cord which allows personnel to operate the crane from positions away from the fume source, thus reducing this problem.

(4) It was suggested that the spacing provided in the accelerator and brake pedal area is insufficient for an operator wearing arctic boots. This 9.5-inch space will accommodate a 5-inch wide arctic boot. No problem was reported during arctic testing, where full arctic protective garments were worn.

(5) The driver's forward visual ground intercept (line of sight to the roadway, viewed over the hood) did not meet the requirement of MIL-STD-1472 (10 feet). A new driver's seat has been incorporated, which provides additional adjustment that elevates the lower percentile operator sufficiently to meet this requirement.

(6) The separation between some of the controls located on the driver's instrument panel and the lack of labels on other controls were reported. The controls were relocated and labeled with appropriate (NATO) symbols to overcome this problem.

(7) It was reported that it was difficult to ingress and egress to and from the cargo bed area due to lack of footholds and handholds. An appropriate ladder has been incorporated to facilitate access to the cargo area.

(8) It was reported that the side panels on the prototype vehicle cargo bed would jam occasionally, making them difficult to raise or lower. These panels have been modified and no problems were reported during testing.

(9) A test subject reported that the shoulder belt had a tendency to "ride up too high" on the neck. The shoulder belt has been reconfigured and this problem has not reoccurred.

(10) The front convoy light did not meet "percentage of peak emissions for infrared, compared to visible light" secure lighting criteria. It was recommended that this light be modified or replaced to meet this requirement; this problem is still being investigated. The subject light is government furnished equipment (GFE) and cannot be considered a contractor fault.

4. **Positive Aspects of the System.** The Manpower, Personnel and Training requirements for the FMTV are predicted to be superior to its predecessors and represent a reduced workload for the designated military occupational speciality (MOS) which perform the hands-on maintenance of these vehicles. Generally, the FMTV design requirements dictate that it be both more reliable (i.e., fewer failures per mile of operation) and more maintainable (i.e., less time to repair when failures occur) than the predecessor vehicles. Initial FMTV testing indicates that contractual requirements for reliability and maintainability are being met.

a. Several sources of quantitative data as referenced under section IIB, Data Sources were investigated in order to compare the maintenance man-hours required for the emerging FMTV to the predecessor vehicles. The results of this investigation indicate that the greatest variance occurs between the 2 1/2-ton LMTV and the M35A2 series vehicles.

b. In order to document specific examples of what accounts for these man-hour savings, the TACOM Fleet Planning Office examined the Maintenance Allocation Charts (MAC) for both the LMTV and the M35A2 for various vehicle components which were suspected of being maintenance man-hour intensive. The number of times per year that each of these parts is expected to fail was determined for the M35A2 by examining all the maintenance incidents in the sample data collection (SDC) data base for these components. Multiplying failures per year by maintenance man-hours per failure (as stated in the MAC) gives maintenance man-hours per year by component. The LMTV data in the following table shows the difference in man-hours if the LMTV components had equal reliability (fail as often) as those on the M35A2.

**COMPARISON OF MAINTENANCE MAN-HOUR INTENSIVE COMPONENTS**

| | LMTV | | | M35A2 | | |
|---|---|---|---|---|---|---|
| | Unit | Direct | General | Unit | Direct | General |
| | 63B | 63W | 63W | 63B | 63W | 63W |
| Component | | | | | | |
| Axle Rear | | | | | | |
| Replace | | 0.75 | | 1.51 | | |
| Repair | 0.39 | 0.13 | 1.00 | | 2.34 | |
| Engine | | | | | | |
| Replace | | 5.69 | | | 5.69 | |
| Repair | 0.65 | 0.49 | 2.60 | | | 13.01 |
| Brake Shoe | | | | | | |
| Replace | 2.98 | | | 5.96 | | |
| Repair | | 0.99 | | | 0.99 | |
| Generator | | | | | | |
| Replace | 0.81 | | | 0.81 | | |
| Repair | | 0.57 | | | 2.03 | |

c. Based on the improved failure rates for the LMTV (per limited initial testing) compared to the Sample Data Collection rates for the M35A2, it was estimated that the LMTV failure rate for the components listed will be approximately one quarter that of the M35A2. The TACOM Fleet Planning Office has estimated that MOS 63B (LT. WHL. VEH. MECH) at unit level requires 106 man-hours per 3450 mile/year for the M35A2, whereas the LMTV requires only 22 man-hours.

## III. Identification and Assessment of Human Engineering Problems and Concerns

A. Scope. This HEA focused on the following areas: (1) personnel heat stress; (2) MPT resources (see para 11 D 4); (3) ingress and egress to the vehicle; (4) lack of communication between troop seat occupants and driver; and (5) inadequate access to the vehicle battery.

B. Critical Problems and Concerns.

1. A critical problem or concern is a system characteristic which, if not remedied, could reasonably be expected to result in death or serious bodily injury; mission abort; system loss; inability of the system to perform its intended mission; or an unacceptable impact on system manpower, personnel, or training (MPT) requirements.

2. No critical problems or concerns were identified.

C. Major Problems and Concerns.

1. A major concern or problem is a system characteristic which, if not remedied, could reasonably be expected to result in major bodily injury, significantly reduced mission effectiveness, extensive system damage, seriously diminished system capacity to perform its intended mission, or a significant negative impact on system MPT requirements.

2. The following major problem was identified: Although Yuma Proving Ground ambient temperatures did not exceed 107°F during testing, a concern was expressed that the vehicle occupants may be at risk when operating at temperatures near the required 120°F in which the vehicle is required to perform.

a. Operational Significance. The ambient temperature considered to be the maximum limit for reliable human performance is 85°F. The mental performance of personnel may be significantly degraded if workstation temperatures exceed this limit. For example, cognitive and vigilant performance tasks, such as those required of the operators of the precision equipment housed within the van or those required of the driver during extended missions, may be degraded to a level where personnel injuries or damage to equipment may result. Since it is never certain when mission oriented protective posture level IV (MOPP-IV) protective garments (which can significantly increase heat stress) will be required, thus provisions to reduce the additional task degradation which is associated with MOPP IV are essential.

b. Discussion. Findings for cognitive and vigilant performance tasks extracted from the report, Environmental Medicine Support for Desert Storm and a related document Isodecrement Curves for Task Performance in Hot Environments, indicate the following:

(1) For cognitive tasks, i.e., mental calculations, visual search, classification and coding; a person could perform for approximately 60 minutes at 88°F without any performance decrements. At 90 minutes, performance decrements would be at 30%; at 140 minutes, it would be at 50%; and at 175 minutes, it would be 100%.

(2) For vigilance tasks, such as tracking and sustained attention conducted for 90 minutes, performance will decrease 50% at 80°F and 100% above 100°F.

c. Recommendation. Include macroclimatic cooling in all FMTV workstations, so that it will be available to maintain the temperature at or below 85°F when required. Include microclimatic cooling in all FMTVs which are sent outside of the Continental United States (CONUS), especially during wartime.

D. Minor Problems and Concerns.

1. A minor concern or problem is a system characteristic which, if not remedied, could reasonably be expected to result in soldier discomfort or minor bodily injury, reduced mission effectiveness, system damage, or a negative impact on system MPT requirements.

2. The following minor concerns were identified:

a. **Concern: Vehicle cab first step height.** Shortcomings regarding egress and ingress to the cab were reported in the draft test reports from Yuma Proving Ground (YPG) and Aberdeen Proving Ground (APG) "Lowest step used for entering FMTV cab is too high at 26 inches above the ground."

(1) Operational Significance. Any group of soldiers chosen from the Military Occupational Specialties (MOS) assigned to operate or maintain the FMTV require access to the vehicle cab including 5th percentile female personnel (ref AR 611-201). Access to a step which is higher than the user's kneecap degrades task performance, particularly when the subject is fatigued or injured. The kneecap height of a 5th percentile female is 17 inches (MIL-STD-1472). Therefore, she must exert more effort to use a 26-inch step than a larger percentile individual, such as a 95th percentile male with a 23-inch high kneecap.

(2) Discussion. The existing cab step already intrudes into the vehicle approach angle (line from front bumper to the front tire) and is supported by flexible cable to allow for ground contact during off-road travel. Extending the length of the flexible step support should not degrade vehicle mission performance.

(3) Recommendation. Lower the vehicle cab step (20 inches above ground level) to accommodate smaller percentile personnel.

b. **Concern: Shortcomings regarding the design of the LMTV van's rear entrance ladder.** The soldier-machine interface for this ladder is degraded due to its steep angle, narrow step width, and lack of an appropriate handrail.

(1) Operational Significance. This rear entrance ladder is utilized by personnel who may be carrying equipment or other unwieldy objects

into or out of the van, especially during inclement weather or at night. Slip-and-fall injuries or damage to equipment could result if the ladder provided does not meet the human engineering criteria specified in MIL-STD-1472D, paragraph 5.7.7.

(2) Discussion. The intended use of this boarding ladder, i.e., access to a parked van during an extended period of time, is considered different from most nonfixed vehicle boarding ladders, which are typically utilized for short-term access to the cab or cargo body troop seats. Its use by personnel who are carrying things into and out of the van requires that it meet the more stringent characteristics associated with a fixed ladder, such as handrails, etc. Since a person who is carrying something up or down a ladder will only have one hand free to grasp a handrail and since it is not known which hand may be free, both a right and a left handrail should be included. Step depth should be 6 inches minimum, and riser height should be 8 1/2 inches minimum.

(3) Recommendation. Redesign the LMTV van rear entrance ladder to meet the requirements specified for fixed ladders in MIL-STD-1472. This redesign should consider the weight of this proposed ladder so that it is easily lifted by user personnel during stowage procedures. When stowed, the ladder should not block the van doors or otherwise inhibit task performance.

c. **Concern: Lack of communications between troop seat occupants and the driver.** Shortcomings were expressed at the System Safety Working Group meetings for the FMTV concerning the ability of the troops to communicate with the driver in an emergency when the vehicle is moving.

(1) Operational Significance. Since the vehicle can be driven with only one person in the cab and that person may not notice activities in the cargo body while engrossed in the driving task, it is possible that various personnel emergencies could occur without the driver's knowledge. The consequences of such emergencies could affect the welfare of personnel or result in equipment damage if the driver is not alerted in time.

(2) Discussion . The distance (approximately 5 feet) between the driver and the closest troop seat makes it difficult to get the driver's or cab passengers' attention when the vehicle is moving, especially if the cargo body cover is installed. In other troop transports where the cargo body is immediately adjacent to the cab, it is easier to alert the driver, e.g., rapping on the rear window or the cab sheet metal.

(3) Recommendation. Include an intercom system with each troop seat kit to provide communications between the troops and driver during emergencies. If it is not feasible to include an intercom, provide with each troop seat kit a battery-powered harness assembly which incorporates a guarded switch and buzzer to alert the driver. If some other method or device is adopted to perform this function, it should be functional in inclement weather as well as daytime or nighttime conditions. The device chosen should meet the applicable requirements of MIL-STD-1472.

d. **Concern: Lack of access to the vehicle batteries.** Shortcomings were reported in the draft YPG and APG test reports concerning the inspection, maintenance, and replacement of the vehicle batteries.

(1) Operational Significance. Lack of adequate battery access, which restricts safe and effective maintenance procedures, exposes personnel to hazards and may result in equipment damage.

(2) Discussion. The four vehicle batteries are located under the left forward portion of the cargo body. They are mounted in two rows on a fixed tray, i.e., it does not slide out for battery maintenance. It is difficult to inspect battery fluid levels, and check for terminal corrosion and cable integrity without using a flashlight and an extension mirror. It is awkward to view the battery in this fashion without inadvertently shorting out the terminals. Replacement of the inboard batteries is time consuming and awkward because the outboard batteries must be removed in order to reach the inboard batteries.

(3) Recommendation. Redesign the vehicle battery housing by replacing the fixed tray with a unit that slides out for easy inspection and easy access to all four vehicle batteries. It should include easily operable latches and should be sealed to prevent road debris and moisture from entering the battery compartment.

## IV. Conclusions and Recommendation

A. Conclusions. This HEA for the Family of Medium Tactical Vehicles (FMTV) does not anticipate any Human Engineering problems or concerns which warrant a delay of this program to the next phase of the acquisition process based on the following:

1. Generally, the FMTV will utilize the same basic population of operators and maintainers performing tasks similar to the ones performed on the predecessor vehicles within the same general environmental ranges. However, some skills may require upgrading due to the modernization of vehicle equipment.

2. Since the FMTV has a much lower maintenance ratio than its predecessors, it is predicted that it will be approximately four times more reliable than the vehicles it replaces.

3. All aspects of human capabilities and limitations which influence mission effectiveness such as human strength, anthropometric size, mental capabilities, fatigue, effects of noise and heat, etc., apply to the predecessor vehicles and also to the technically superior FMTV. The FMTV having been optimized through continuous surveillance by Human Engineering and other MANPRINT specialists will minimize these potential issues.

4. The overall soldier-machine interface for the FMTV is superior to that of the predecessor vehicles.

B. Recommendation.

From a Human Engineering standpoint and based on the data available, it is recommended that the Family of Medium Tactical Vehicles' program transition to the Full Rate Production Phase of the Materiel Acquisition Life Cycle with priority attention directed to the specific problems and concerns identified herein.

## V. Preparing Activity

This Human Engineering Assessment was prepared by the U.S. Army Research Laboratory, Human Research and Engineering Directorate (HRED) Field Element located at the U.S. Army Tank-Automotive Command, Warren, MI 48397-5000. The point of contact is Mr. Ralph Akens, DSN 786-6338.